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this not alone in the tissues of the cats, but in artificial cultures on egg and serum made from them, and on one occasion in the organs of a rabbit infected from the cat. I do not know whether a tendency to grow to greater length than usual has been observed in tubercle bacilli obtained from other cats, and on this account these observations may be worth a brief notice. But I do not attach much importance to them because of the great variation in length and other morphological characters which may be seen in any given strain of tubercle bacilli under different circumstances of growth. I have recently seen them very long in a rabbit.

Cat No. 3.—A third cat was the subject of a partial investigation. Its kidneys alone came into my hands. I believe there was very little obvious disease elsewhere, for had there been I do not think the veterinary surgeon who kindly sent me the kidneys would have omitted to include the other organs also.

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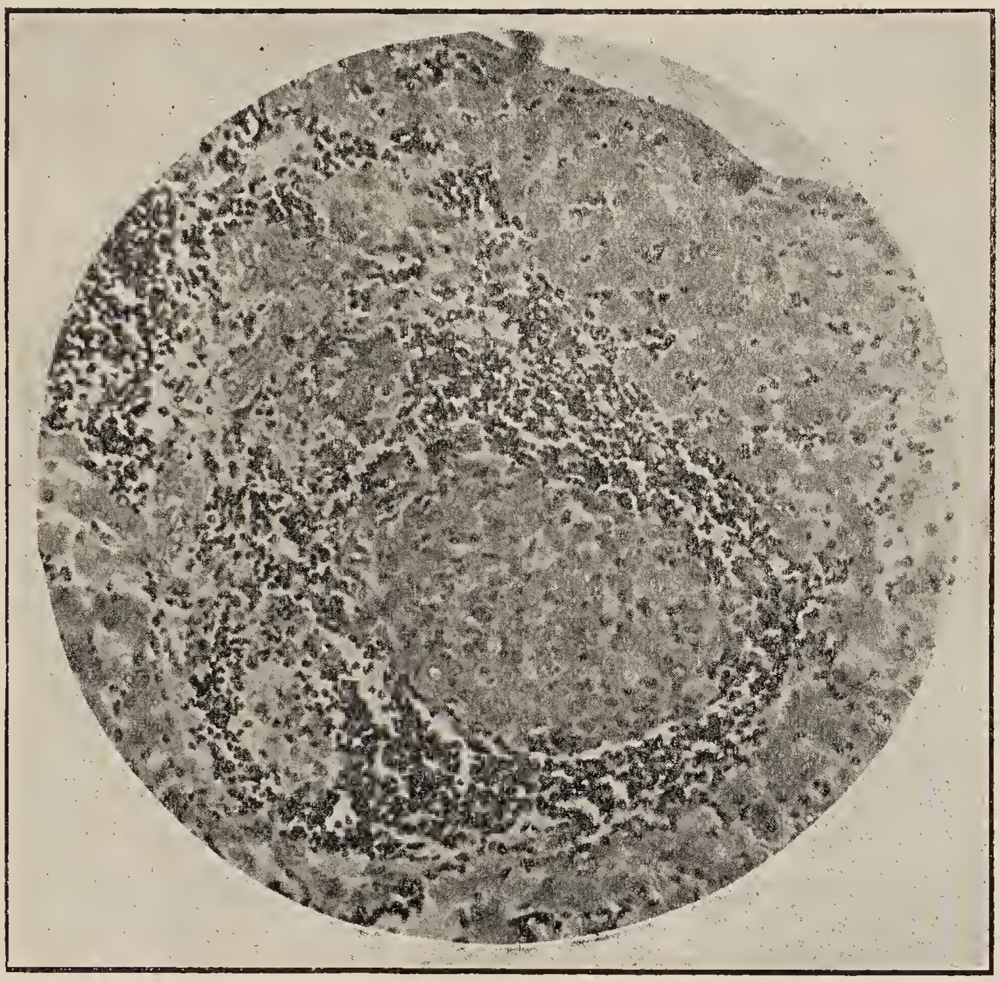

FIG. 3.

A tubercle in the liver of a cat, surrounded by a highly vascular zone, in which the red corpuscles stand out as conspicuous dark objects; stained with hæmatoxylin and eosin. × 160.

The kidneys differed much in size, one being six times as large as the other; the former was as large as a bantam's egg, and weighed $27\frac{1}{2}$ grammes, and the latter no bigger than that of a thrush, and weighed $4\frac{1}{2}$ grammes. The larger kidney was, apparently, normal. Of the smaller, the pelvis was full of curdy pus containing some granular tubercle bacilli. This material was sown on egg medium and injected intraperitoneally into a rabbit and subcutaneously into a guinea-pig. Both animals died of general tuberculosis with the usual lesions, the former in 112 days and the latter in sixty-six. It is recorded of the tubercle bacilli in the tuberculous omentum of the rabbit that they were short.

Unfortunately the record of the cultures has been lost; but from the animal experiments alone there can be no doubt that the strain of tubercle bacilli with which the cat was injected was, like those of Cats 1 and 2, of the bovine type.

If these three cases be added to those collected by Griffith, it brings the number of tuberculous cats in which the type of tubercle bacillus found in the lesions has been determined to sixteen.

In all these cases the bacilli were typical examples of the bovine type, and of full virulence for the rabbit.

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LAMB DYSENTERY.

AN ACCOUNT OF SOME EXPERIMENTAL FIELD WORK IN 1925 AND 1926.

By T. Dalling, M.R.C.V.S., Langley Court, Beckenham, Kent.

Section I.

Artificial Reproduction of Lamb Dysentery.

FURTHER experimental field work in lamb dysentery infected districts in Northumberland and the south of Scotland has been conducted during 1925 and 1926 to investigate the methods of the artificial production of the disease and the possibility of protecting lambs against its natural occurrence. A considerable amount of time was spent each spring in the field, and a temporary laboratory was set up in Northumberland.

The first records of the successful artificial reproduction in lambs of a disease clinically identical with the naturally occurring condition, were in 1923, (1) when the feeding of young healthy lambs with (*a*) intestinal contents of naturally infected lambs, and (*b*) a mixture of cultures of B. welchii and B. coli, apparently gave rise to the disease. During 1925 and 1926 we have carried out experimental work on similar lines, and in addition have investigated the results of the introduction of similar substances into young lambs by routes other than the mouth.

In 1925 twenty-five young healthy lambs were used. They were procured from clean farms on which lamb dysentery has never been known, and on removal from their mothers they were kept at the field laboratory, cow's milk forming their diet during experimentation. In 1926 lambs born from thirty Cheviot ewes were used; these ewes came from a farm and flock in which lamb dysentery is unknown; they were removed a few days prior to the beginning of

Inoculation of Ewes.	*No. of Observations.*	χ^2
	Lambs Born.	
Double Inoculation—Autumn and Spring	3882	316·3
Single Inoculation—Spring . . .	3958	67·8
,, ,, Autumn . . .	923	5·9
Individual Farms. Double Inoculation.		
Farm A. Breed, Cheviot . . .	91	9·9
,, C. ,, ,, . . .	574	28·2
,, E. ,, ,, . . .	420	14·7
,, B. ,, Half-Bred . . .	102	1·5
,, D. ,, ,, . .	347	46·9
,, G. ,, ,, . . .	209	10.6
Serum on Young Lambs, injected soon after birth	881	89·0

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lambing to fields where for many years cattle only had been grazed. The lambs sucked their mothers throughout the experiment.

Infection with Natural Material.

(*a*) *Feeding.*—In 1925 we were unable to infect lambs by feeding intestinal contents, ground-up ulcers, etc., from natural cases; *e.g.*, one two days old lamb was fed a quantity of such material, obtained from three naturally infected lambs, suspended in saline solution, but showed no symptoms. In 1926 the technique was altered somewhat. After failure to infect two young lambs, material from hyperacute cases only was used; this was mixed with glucose broth and fed by stomach tube to two healthy lambs under twelve hours old; infection took place and death occurred within forty-eight hours. In a subsequent experiment five lambs less than twelve hours old were given by the mouth 30 cc. of intestinal contents of naturally infected lambs. Two of these received 10 cc. of normal horse serum intraperitoneally; one, and the control lamb, died with typical symptoms in forty-eight hours. The other passed blood-stained mucus for several days but eventually recovered. The other two lambs, which received 10 cc. B. welchii antiserum, showed no symptoms. The serum which was obtained from horses by the injection of strains of B. welchii isolated from naturally occurring cases apparently gave complete protection.

(*b*) *Intravenous Inoculation.*—In 1925 (2), and again in 1926, we reproduced in lambs lesions resembling macroscopically those found in naturally occurring cases by the intravenous injection of intestinal contents of acutely affected lambs. The results of these experiments appear in Table I. The only lamb which received B. welchii antiserum, six hours prior to the intravenous inoculation of intestinal contents, lived.

(*c*) *Umbilical Infection.*—In 1925 (2) an ulcer from the intestine of an affected lamb was inserted into the open umbilicus of a young healthy lamb. On the fourth day the lamb was killed and several ulcers were found in the intestinal mucous membrane. We have attempted this method of reproduction on many occasions during the past lambing season, and, in addition, on twelve occasions we have inserted into the open umbilicus actual intestinal contents from lambs acutely affected; but, although four of the experimental lambs have died after such treatment, we have never been able to satisfy ourselves that we have reproduced a condition simulating the natural disease.

Infection by the Use of Cultures of Organisms.

The cultures used have been strains of B. welchii and B. coli isolated from naturally affected lambs.

(*a*) *Feeding.*—The feeding of cultures of B. welchii and B. coli together, as was done in 1923 (1), has been repeated on six occasions with similar successful results when young lambs only have been the experimental animals. We have also shown that infection can be prevented by an intraperitoneal injection of B. welchii antiserum ten hours prior to feeding. B. coli antiserum did not protect (*see* Table II.). While experimenting on the same lines during the past lambing season, a highly virulent culture of B. welchii (the virulence of which was exalted by intramuscular passage through three healthy lambs) was used, and we found that a culture of this organism alone reproduced the condition, young healthy lambs dying as rapidly as those fed with a mixture of the two bacilli. Such infection is prevented by the use of B. welchii antiserum (*see* Table III.). The results shown in the first part of Tables II. and III. are difficult to interpret or reconcile. The result shown in Table II. (*a*) was obtained on six occasions three and two years ago; the obvious suggestion was that B. welchii alone *per os* would not cause the disease, but that the combination of B. welchii and B. coli would do so. We therefore decided to attempt prophylaxis with double vaccine and serum made with B. welchii and B. coli. To our surprise in 1926 (Table III. (*a*)) the culture of B. welchii *per os* reproduced the disease in a fatal form as certainly and quickly as the mixture of B. coli and B. welchii in the only clean experiment we were able to carry out. The explanation of the discrepancy is not yet clear. It is of interest that the culture used in the experiment in Table IV. had been passed through three lambs by intramuscular injection and recovered from the heart blood. From the rapidity with which typical symptoms of the disease and death occurred in the lambs, recorded in Table III., which were fed with cultures of B. welchii alone, we are at present of opinion that the feeding of B. welchii alone, in an appropriate condition of pathogenicity, will produce the disease.

(*b*) *Intravenous Inoculation.*—Intravenous injection of small doses of a virulent B. welchii culture has produced the most characteristic artificially produced lesions we have seen in our experimental work. The character of the lesion varies from acute to chronic, depending on the dose of culture injected. B. welchii antiserum when injected intraperitoneally six hours before the culture is given confers full protection (Table IV.); B. coli antiserum did not protect. As a control experiment, a culture of Vibrion septique of sheep origin was injected intramuscularly into a young lamb. A pure culture was recovered. Two healthy lambs, not twelve hours old, received each ·5 cc. intravenously. No symptoms of any kind occurred.

(*c*) *Intravenous Inoculation of B. coli followed by Feeding B. welchii.*—Table V. indicates the results of experiments on this method of infection carried out in 1925 and 1926. Whereas in 1925 the B. coli culture failed to produce any untoward symptoms when injected intravenously (Lamb 4), in 1926 it caused the death of one lamb twenty-four hours after the operation; no lesions associated with the natural disease were found.

(*d*) *Via Umbilicus.*—We have not been able to infect lambs by the introduction of cultures into the umbilicus. Three lambs have died subsequent to such treatment, but in no case have lesions associated with lamb dysentery been present.

TABLE I.

Intestinal Contents, Ulcers, etc., from Affected Lambs. Intravenous Inoculations. (1925).

Lamb.	*Dose.*	*Result.*	
1	1·0 cc.	+48 hours.	P.M.T.
2	0·1 cc.	+ 3 days	P.M.T.
3	0·5 cc.	+48 hours.	P.M.T.
4	1·0 cc.	+48 hours.	P.M.T.
5	2 cc. mucous scrapings normal lamb's bowel	L.	

Intestinal Contents, etc. Intravenous Inoculation. Serum Experiments. (1926).

Lamb.	*Serum.*	*Result.*	
1	N.H.S., 10 cc.	+30 hours.	P.M.T.
2	B. coli, 10 cc.	+36 hours.	P.M.T.
3	B. welchii, 10 cc.	L.	
4	Nil	+30 hours.	P.M.T.

Lambs up to twelve hours old only used. Serum injected six hours before intravenous injection of ·05 cc. of inoculum.

In this and the following tables:—

P.M.T. = *Post-mortem* typical of natural lamb dysentery, *i.e.*, enteritis, hæmorrhages in intestinal mucous membrane, ulceration, etc., in varying degrees.

L. = Lived. + = Died. N.H.S. = Natural horse serum.

TABLE II.

Feeding Cultures.

(*a*) *Infection by B. welchii + B. coli.* (1925).

Lamb.	*Culture.*	*Result.*	
1	50 cc. B. coli + 50 cc. B. welchii	+48 hours.	P.M.T.
2	20 cc. B. coli + 20 cc. B. welchii	+ 3 days.	P.M.T.
3	100 cc. B. coli	L.	
4	100 cc. B. welchii	L.	
5	40 cc. B. coli	L.	
6	40 cc. B. welchii	L.	

(*b*) *Feeding Cultures. Serum Experiments.* (1925).

Lamb.	*Serum.*	*Cultures.*		*Result.*	
		B. welchii	B. coli		
1	B. welchii, 10 cc.	50 cc. +	50 cc.	L.	
2	B. welchii, 10 cc.	20 cc. +	20 cc.	L.	
3	B. coli, 10 cc.	50 cc. +	50 cc.	+48 hours.	P.M.T.
4	B. coli, 10 cc.	20 cc. +	20 cc.	+ 3 days.	P.M.T.
5	N.H.S., 10 cc.	20 cc. +	20 cc.	+ 3 days.	P.M.T.
6	N.H.S., 10 cc.	20 cc +	20 cc.	+ 3 days.	P.M.T.

Serum injected intraperitoneally ten hours before cultures fed.

TABLE III.

(*a*) *Infection by feeding B. welchii.*

Lamb.	*Culture.*	*Result.*	
1	30 cc. B. welchii + 30 cc. B. coli	+48 hours.	P.M.T.
2	50 cc. B. welchii + 30 cc. B. coli	+48 hours.	P.M.T.
3	60 cc. B. welchii	+48 hours.	P.M.T.
4	50 cc. B. welchii	+48 hours.	P.M.T.
5	60 cc. B. coli	L.	
6	50 cc. B. coli	L.	

(*b*) *Feeding B. welchii Culture. Serum Experiments.*

Lamb.	*Serum.*	*Result.*	
1	Nil	+48 hours.	P.M.T.
2	10 cc. N.H.S.	+48 hours.	P.M.T
3	10 cc. N.H.S.	L.	Clinically affected.
4	10 cc. B. welchii	L.	
5	10 cc. B. welchii	L.	

Serum injected intraperitoneally same time as 50 cc. of culture fed
Only lambs under twelve hours used.

TABLE IV.

B. welchii Culture. Intravenous Inoculation.

Lamb.	*Dose.*		*Result.*
1	1·0 cc.	+6-8 hours.	Intense congestion of intestinal mucous membrane with hæmorrhages.
2	0·5 cc.	+6-8 hours.	
3	0·05 cc.	+36 hours.	P.M.T.
4	0·05 cc.	+36 hours.	P.M.T.
5	0·250 cc.	L.	
6	0·250 cc.	L.	

B. welchii Culture. Serum Experiments.

Lamb.	*Serum.*	*Result.*	
1	B. welchii, 10 cc.	L.	
2	N.H.S., 10 cc.	+48 hours.	P.M.T.
3	Nil.	+ 3 days.	P.M.T.
4	B. welchii, 10 cc.	L.	
5	B. coli, 10 cc.	+36 hours.	P.M.T.
6	N.H.S., 10 cc.	+36 hours.	P.M.T.
7	Nil.	+36 hours.	P.M.T.
8	B. welchii, 10 cc.; B. coli, 10 cc.	L.	

All lambs received ·05 cc. of culture intravenously; serum intraperitoneally six hours earlier.
Lambs up to twelve hours only used.

TABLE V.

Inoculations of B. coli Intravenously and the Feeding of B. welchii.

1925 *Experiments.*

Lamb.	*B. coli I.V.*	*B. welchii per os.*	*Result.*
1	2·0 cc.	60 cc.	+ 48 hours. P.M.T.
2	2·0 cc.	50 cc.	+ 3 days. P.M.T.
3	2·0 cc.	50 cc.	+ 3 days. P.M.T.
4	2·0 cc.	Nil	L.
5	Nil	50 cc.	L.

1926 *Experiments.*

Lamb.	*B. coli I.V.*	*B. welchii per os.*	*Result.*
1	1·0 cc.	Nil	+ 24 hours.
2	1·0 cc.	30 cc.	+ 36 hours. P.M.T.

B. coli inoculated six hours before B. welchii fed.
Young lambs under twelve hours only used.

SECTION II.

PROPHYLAXIS.

By T. DALLING and J. H. MASON, Langley Court, Beckenham, and H. M'D. PAUL, Glanton, Northumberland.

The Use of Vaccine on Ewes.

The use of a sero-vaccine made from B. coli in pregnant ewes was described in 1923 (1). A preliminary experiment was carried out in 1924 in collaboration with Professor Gaiger. Pregnant ewes were inoculated with a vaccine composed of B. welchii toxin-antitoxin mixture and killed B. coli suspension, but the results were unsatisfactory. It would now appear that the cause of this was that the injections were made too late in the season. We have recorded elsewhere the results of vaccinating pregnant ewes with a similar vaccine (1925) (2).

Two groups of experiments were carried out:—

(*a*) Control and inoculated ewes were herded together and careful records were kept. Of lambs from 514 inoculated ewes 2·4 per cent. died of lamb dysentery, while 24 per cent. of lambs born from 393 uninoculated control ewes died of the same disease.

(*b*) Control ewes were partly in adjoining fields and records were not so carefully kept. Of lambs born from 307 inoculated ewes 5·2 per cent. died of lamb dysentery; controls (740) 20·7 per cent. In these experiments the ewes were inoculated once or twice within a month of the beginning of lambing.

Experiments on a much larger scale were carried out in 1926. Groups of ewes on forty-six farms in Northumberland and on six farms in the south of Scotland were inoculated at various times, viz. (*a*) once in autumn and once in spring, (*b*) once only in spring, (*c*) once only in autumn, and (*d*) twice in spring. Ewes in the same flocks, of the same breed and age and not selected in any way, were left uninoculated as controls. Autumn inoculations were carried out in September and October, while the spring, two to three weeks before lambing, was chosen as the most suitable time for the operations. When two spring injections were done the times chosen were four and two weeks before lambing was due to begin in the flock. Injections were done subcutaneously in the inside of the thigh.

Northumberland Results.

The total number of inoculations made in the Northumberland area was 16,971 in 12,806 ewes. 5439 ewes were injected in the autumn, and, but for a temporary stiffness of two days' duration, no inconvenience was observed. In the spring 11,532 injections were done. We were much disturbed to find that the general effect of inoculation in the spring was in some instances more severe than in autumn. We cannot decide on the evidence whether this difference was due to a possibly greater liability of the heavily pregnant ewe in spring to react to inoculation. In the affected flocks lameness and inability to move were marked in some sheep from the sixth hour, and these sheep lay about and ceased feeding for one or two days, but by the third day lameness had generally disappeared and the flock was feeding normally and quickly regained condition. A necrotic condition of the skin of the injected thigh was seen in about 100 sheep on different farms. This condition persisted for three to four weeks and then completely healed up. Sixty-five ewes died within one week of the inoculation, and, if the whole of these are taken as due directly to the injection, the inoculation must be charged with ·57 per cent. mortality amongst the ewes inoculated. The vaccines were carefully examined subsequently and were all sterile. The local reaction is therefore due either to the specific bacterial toxins or to non-specific material.

A programme of further research in this connection has already been begun. It is reasonable to anticipate that the factors causing the severe reactions will, by various methods of preparation, be diminished and possibly abolished.

Notwithstanding the severe reaction in some of the sheep, abortions were rare. On one farm only was there any increase of the usual number of abortions due to all causes among the ewes. In this case 180 half-bred ewes were inoculated; the reaction was not severe, but on the seventh day after inoculation one ewe aborted, and twenty-five more cast their lambs during the following three weeks. We have reason to believe that this outbreak of abortion had a specific cause and was not in any way connected with the inoculations.

No reports have been obtained that the inoculations anywhere have interfered with the normal course of lambing or have affected the number of lambs born or their quality or condition.

Chart 1 depicts the results obtained on all farms on which ewes were inoculated twice, *i.e.*, in autumn and spring. Amongst 5760 lambs born of 4724 inoculated ewes, 3·06 per cent. died of dysentery, while 2248 control ewes gave birth to 2509 lambs, of which 16·06 per cent. died of the disease.

In Table VI. we have shown the details of experiments on farms near our field laboratory, on which constant supervision could be kept and autopsies performed on every dead animal. Amongst 2651 lambs from inoculated ewes the mortality from lamb dysentery was 2·34 per cent.; amongst 1231 lambs from uninoculated ewes it was 18·44 per cent. In a further group of seven more distant farms which we were able to visit only three or four times during the lambing season, 3·55 per cent. of 1494 lambs born of inoculated ewes died, while amongst 1278 lambs of 1191 uninoculated mothers 12·99 per cent. died. In a third group of four farms amongst 1615 lambs born of 1201 inoculated mothers 3·77 per cent. died. On these four farms we found that some process of selection had occurred; the controls had been picked out by the farmer to lamb at a different time from the inoculated or they were of a different breed. We have therefore rejected the whole of the controls.

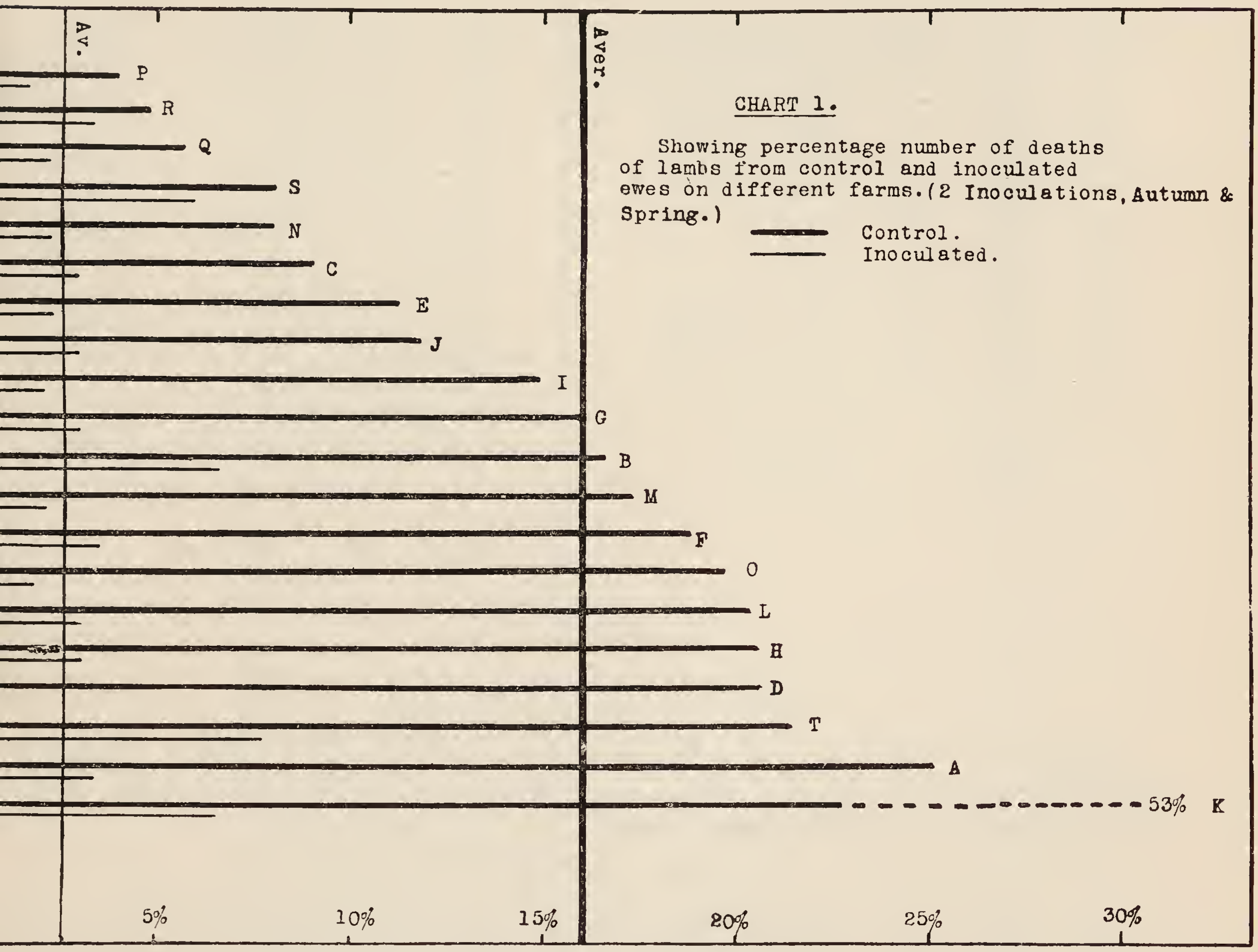


CHART 1.

Showing percentage number of deaths of lambs from control and inoculated ewes on different farms. (2 Inoculations, Autumn & Spring.)

TABLE VI.

Double Inoculation. (Autumn and Spring.)

Farms we visited at least twice a week during the lambing season. Controls same breed, same fields, and not selected in any way. We examined *post-mortem* every dead lamb.

Farm.	*Ewes Inoculated.*	*Breed.*	*Lambs Born.*	*Breed of Lambs.*	*Lambs Died. L.D.*	*Per Cent.*	*Control Ewes.*	*Lambs Born.*	*Lambs Died. L.D.*	*Per Cent.*
A	50	Chev.	59	Chev.	2	3·4	26	32	8	25·00
B	80	,,	90	H.B.	6	6·66	10	12	2	16·66
C	474	,,	474	Chev.	3	0·63	100	100	9	9·00
D	166	,,	255	H.B.	2	0·78	54	92	19	20·65
E	250	,,	260	Chev.	6	2·33	150	160	18	11·25
F	245	,,	330	,,	6	1·82	301	354	68	19·23
G	120	,,	165	H.B.	5	3·03	34	44	7	15·91
H	298	B.F.	298	B.F.	9	3·02	54	54	11	20·37
I	100	,,	100	,,	2	2·00	94	94	14	14·89
J	200	,,	200	,,	6	3·00	85	85	10	11·76
K	108	H.B.	108	H.B.	7	6·47	50	66	35	55·03
L	111	,,	172	Cross	5	2·91	49	74	15	20·27
M	128	B.F.	140	Mule	3	2·14	50	64	11	17·79
	2330		2651		62	2·34	1057	1231	227	18·44

TABLE VII.

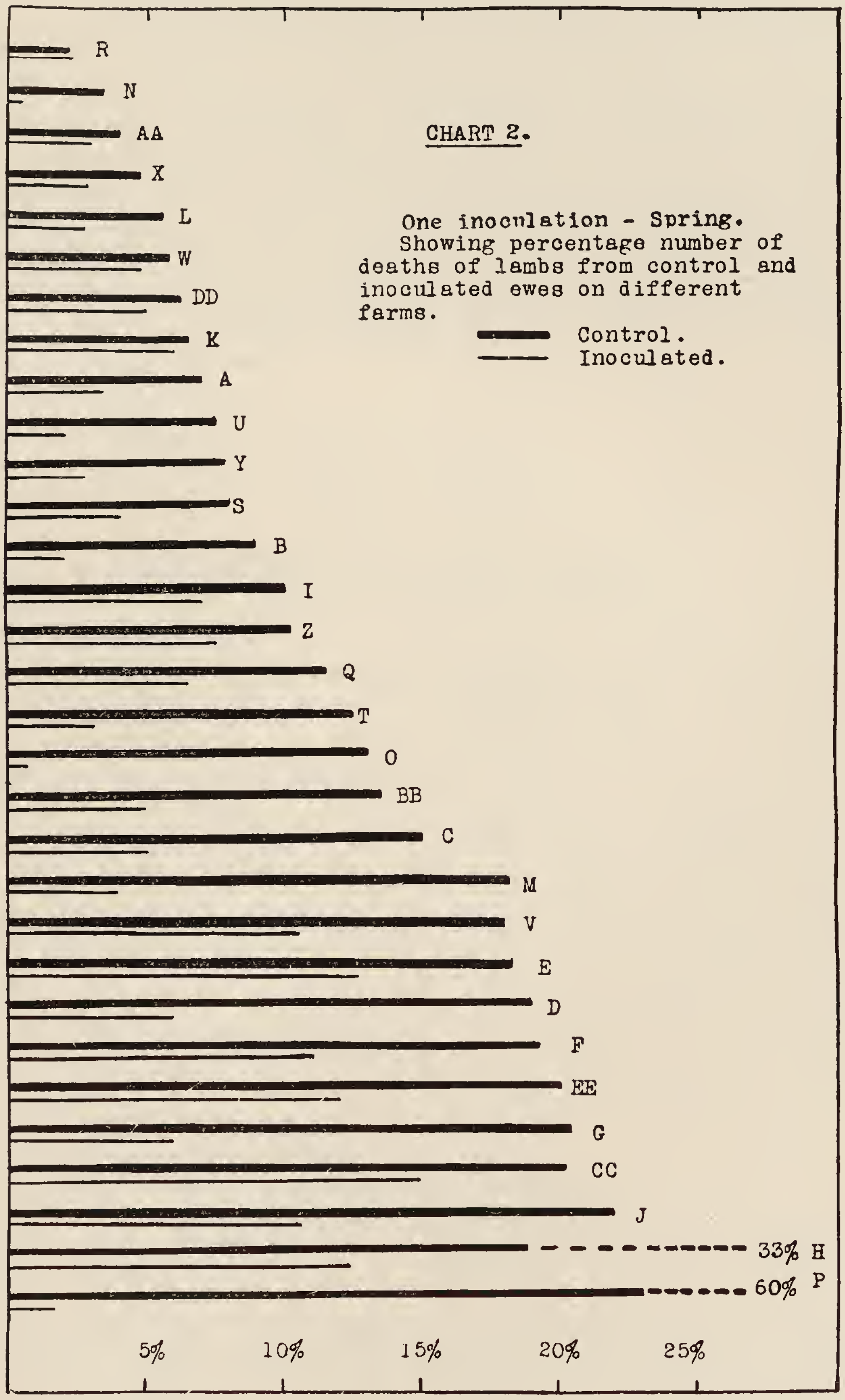
Single Spring Inoculation.

Farms we visited at least twice a week during the lambing season. Controls same breed, same fields, etc., and not selected in any way. We examined *post-mortem* every dead lamb.

Farm.	*Ewes Inoculated.*	*Breed.*	*Lambs Born.*	*Breed of Lambs.*	*Lambs Died. L.D.*	*Per Cent.*	*Control Ewes.*	*Lambs Born.*	*Lambs Died. L.D.*	*Per Cent.*
A	212	Chev.	225	Chev.	8	3·55	334	358	25	7·02
B	252	,,	252	,,	5	1·99	100	100	9	9·00
C	170	H.B.	289	H.B.	15	5·19	38	66	10	15·16
D	168	B F.	208	Mule	13	6·20	303	356	68	18·99
E	156	,,	156	B.F.	23	14·74	458	458	86	18·78
F	303	Chev.	356	Chev.	44	12·36	301	354	68	19·21
G	197	B.F.	197	B.F.	12	6·09	54	54	11	20·37
H	103	,,	103	,,	15	14·56	33	33	11	33·33
I	100	Chev.	143	H.B.	11	6·99	12	20	2	10·00
J	180	,,	180	Chev.	19	10·55	50	50	11	22·00
	1814		2109		165	7·82	1683	1849	301	16·28

Chart 2 summarises the results on all farms on which the ewes received one inoculation between two and four weeks before lambing.

Amongst 8497 lambs born of 7223 inoculated mothers, 456, *i.e.*, 5·34 per cent., died of dysentery; amongst 5131 control lambs from 4633 uninoculated mothers 605 died, *i.e.*, 11·59 per cent. In Table VII. are shown the results obtained on farms under close supervision.



On twenty-two farms where our supervision was less close and where the majority of, but not all, the dead lambs were examined *post-mortem*, the mortality amongst 5887 lambs born of 4927 inoculated mothers was 4·19 per cent., while amongst 3262 lambs from 2950 uninoculated mothers the mortality was 9·66 per cent. On three distant farms which were not under our constant supervision and on which we rejected the controls, the mortality amongst 501 lambs was 8·98 per cent.

Table VIII. and Chart 3 are summaries of the result of a single autumn inoculation. 515 ewes were inoculated and produced 527 lambs, of which 38, or 7·21 per cent., died; against 47, or 11·87 per cent., of the 396 lambs born from 393 control uninoculated sheep. The table also shows the results of a double spring and a triple inoculation.

Table IX. and Chart 4 show the contrast between the results from different methods of inoculations on the same farms.

On Farms I and J, on which we had inoculated many ewes a year previously, the mortality amongst the controls was low; and on enquiry we found that, owing to an oversight, many of the sheep inoculated last year were this year placed amongst the controls. It is at least possible that these sheep had a reasonable degree of immunity resulting from the inoculations in the previous year.

The general indication is that autumn and spring inoculations give greater protection than a single inoculation.

TABLE VIII.

Single Autumn Inoculations.

Farm.	*Ewes Inoculated.*	*Breed.*	*Lambs Born.*	*Breed of Lambs.*	*Lambs Died. L.D.*	*Per Cent.*	*Control Ewes.*	*Lambs Born.*	*Lambs Died. L.D.*	*Per Cent.*
A	100	Chev.	100	Chev.	6	6·00	100	100	9	9·00
B	55	B.F.	55	B.F.	4	7·45	54	54	11	20·37
C	120	,,	120	,,	12	10·00	94	94	14	14·89
D	140	,,	140	,,	10	7·14	85	85	10	11·75
E	100	Chev.	112	Chev.	6	5·36	60	63	3	4·75
	515		527		38	7·21	393	396	47	11·87

Double Spring Inoculation.

Farm.	*Ewes Inoculated.*	*Breed.*	*Lambs Born.*	*Breed of Lambs.*	*Lambs Died. L.D.*	*Per Cent.*	*Control Ewes.*	*Lambs Born.*	*Lambs Died. L.D.*	*Per Cent.*
A	143	H.B.	245	H.B.	3	1·22	14	25	3	12·00

Triple Inoculation. (Once Autumn; Twice Spring).

A	100	H.B.	155	H.B.	2	1·29	50	66	35	53·03

TABLE IX.

Various Types of Inoculation carried out on the Same Farm.

All farms visited frequently and many *post-mortem* examinations done.
Controls same breed, on same ground, etc.

Farm.	*Type of Inoculation.*	*Lambs Born.*	*Lambs Died. L.D.*	*Percentage.*
A	(*a*) Autumn and spring	474	3	0·63
	(*b*) Spring once	282	5	1·99
	(*c*) Autumn once	100	6	6·00
	Controls	100	9	9·00
B	(*a*) Autumn and spring	300	6	1·82
	(*b*) Spring once	356	44	12·36
	Controls	354	68	19·21
C	(*a*) Autumn and spring	440	16	3·63
	(*b*) Spring once	156	23	14·74
	Controls	458	86	18·77
D	(*a*) Twice spring	245	3	1·22
	(*b*) Spring once	225	9	4·00
	Controls	49	5	10·17
E	(*a*) Autumn and spring	298	9	3·02
	(*b*) Spring once	197	12	6·09
	(*c*) Autumn once	55	4	7·45
	Controls	54	11	20·37
F	(*a*) Autumn and spring	100	2	2·00
	(*b*) Autumn once	120	12	10·00
	Controls	94	14	14·89
G	(*a*) Autumn and spring	200	6	3·00
	(*b*) Autumn once	140	10	7·14
	Controls	85	10	11·75
H	(*a*) Triple inoculation	155	2	1·29
	(*b*) Autumn and spring	108	7	6·47
	Controls	66	35	53·03
	(*c*) Spring once	108	15	14·56
	Controls	33	11	33·33
I	(*a*) Autumn and spring	280	6	2·14
	(*b*) Spring once	261	12	4·55
	Controls	142	8	5·36
J	(*a*) Autumn and spring	60	2	3·33
	(*b*) Spring once	242	7	2·89
	(*c*) Autumn once	112	6	5·36
	Controls	63	3	4·76
K	(*a*) Autumn and spring	170	13	7·65
	(*b*) Spring once	60	9	15·00
	Controls	230	49	21·31

The Use of Serum on Young Lambs.

A mixture of B. welchii and B. coli antisera has been used on young lambs. In 1924 and 1925 we got encouraging results. Of 720 lambs injected, 64, or 8·9 per cent., died of lamb dysentery, while the mortality among 365 control lambs was 139, or 38·8 per cent.

During the past lambing season a similar serum has been used. Table X. records some results. We have found that when serum is injected subcutaneously within twelve hours of the lamb's birth the danger of infection with lamb dysentry is slight. The percentage of deaths from the disease following serum inoculations is small (1·9 per cent), and from the evidence of farmers and shepherds it would appear that in all cases where death occurred after serum treatment the injection had been done when the lamb was over twenty-four hours old. On ten farms on which the disease was severe early in this lambing season serum was from a given date injected into all lambs born. Deaths from dysentery ceased immediately the use of serum was begun. 1020 lambs were injected, and of these two died (*i.e.*, ·19 per cent.).

TABLE X.

Serum on Young Lambs.

Serum contained equal amounts of B. welchii and B. coli antiserum; injected as soon after birth as possible. Dose, 10 cc.

Farm.	*Lambs Inoculated.*	*Lambs Died. L.D.*	*Per cent.*	*Lambs not Inoculated.*	*Lambs Died. L.D.*	*Per cent.*
A	28	2	7·1	7	2	28·5
B	174	6	3·4	10	4	40·0
C	44	0	0·0	44	21	48·4
D	180	1	0·55	354	68	19·2
E	30	0	0 0	10	1	10·0
	456	9	1·9	425	106	22·6

A. Controlled experiment.

South of Scotland Results.

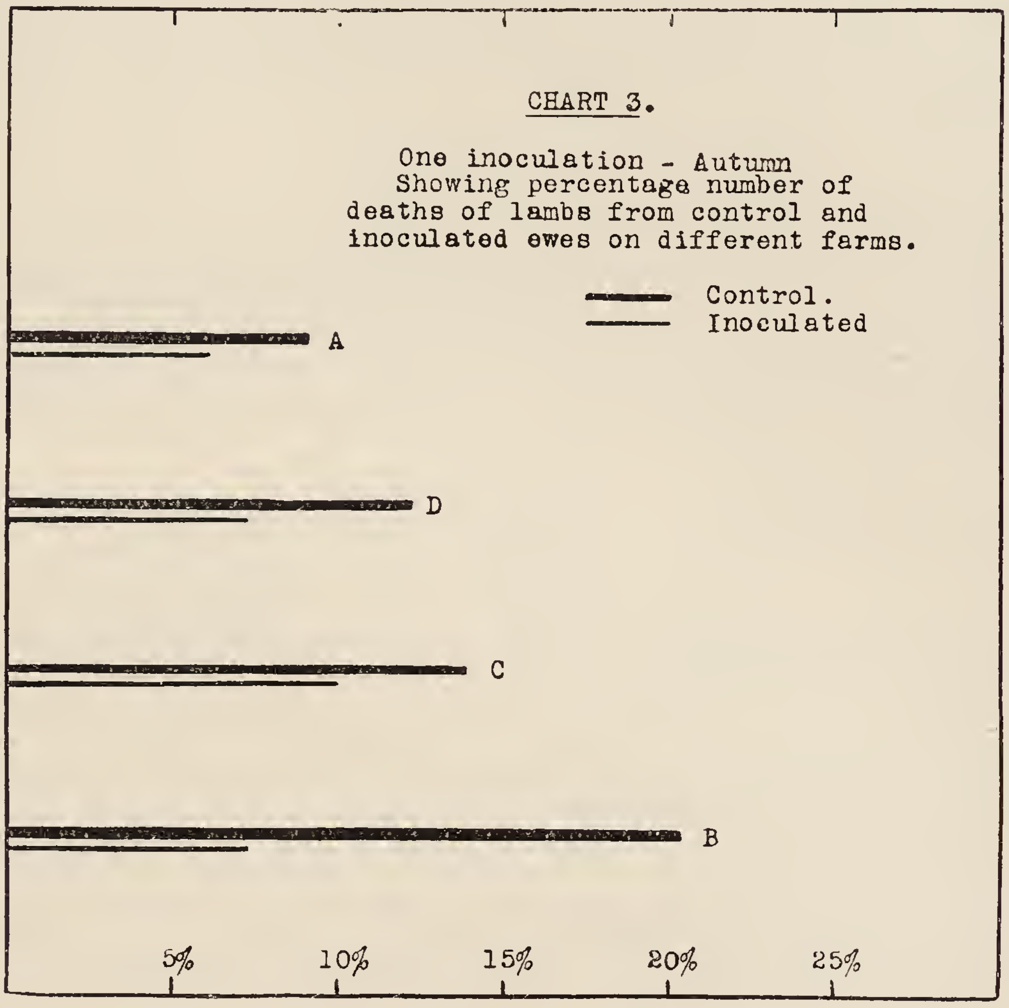
An attempt was made to carry out another experiment on some 4000 ewes in the south of Scotland. Some severe reactions were produced by the spring inoculations and seven ewes died. No abortions were attributed to the inoculations. The figures reported to us are as follows:—

Two spring inoculations: 754 lambs from inoculated ewes; deaths 97, *i.e.*, 12·9 per cent. Controls 873; 125 deaths (14 per cent.).

Single spring inoculation : 748 ; 98 deaths (13 per cent.). Controls 817 ; 110 deaths (13 per cent.).

Single autumn inoculation : 231 ; 20 deaths (9 per cent.). Controls 742 ; 110 deaths (14 per cent.).

Autumn and spring inoculation: 150; deaths 8 (5·3 per cent.). Controls 55 ; deaths 18 (27·69 per cent.).



We feel it our duty to give these figures, but we cannot accept responsibility for them all. Notwithstanding the willing co-operation and generous attempts of the farmers to make the experiment a satisfactory one, full records could not be kept in every case, and very few autopsies were made, and for these and other reasons we regard the experiment as an unsatisfactory one. We were deeply impressed with the necessity of constant skilled veterinary supervision during an enquiry of this kind.

Conclusions and Summary.

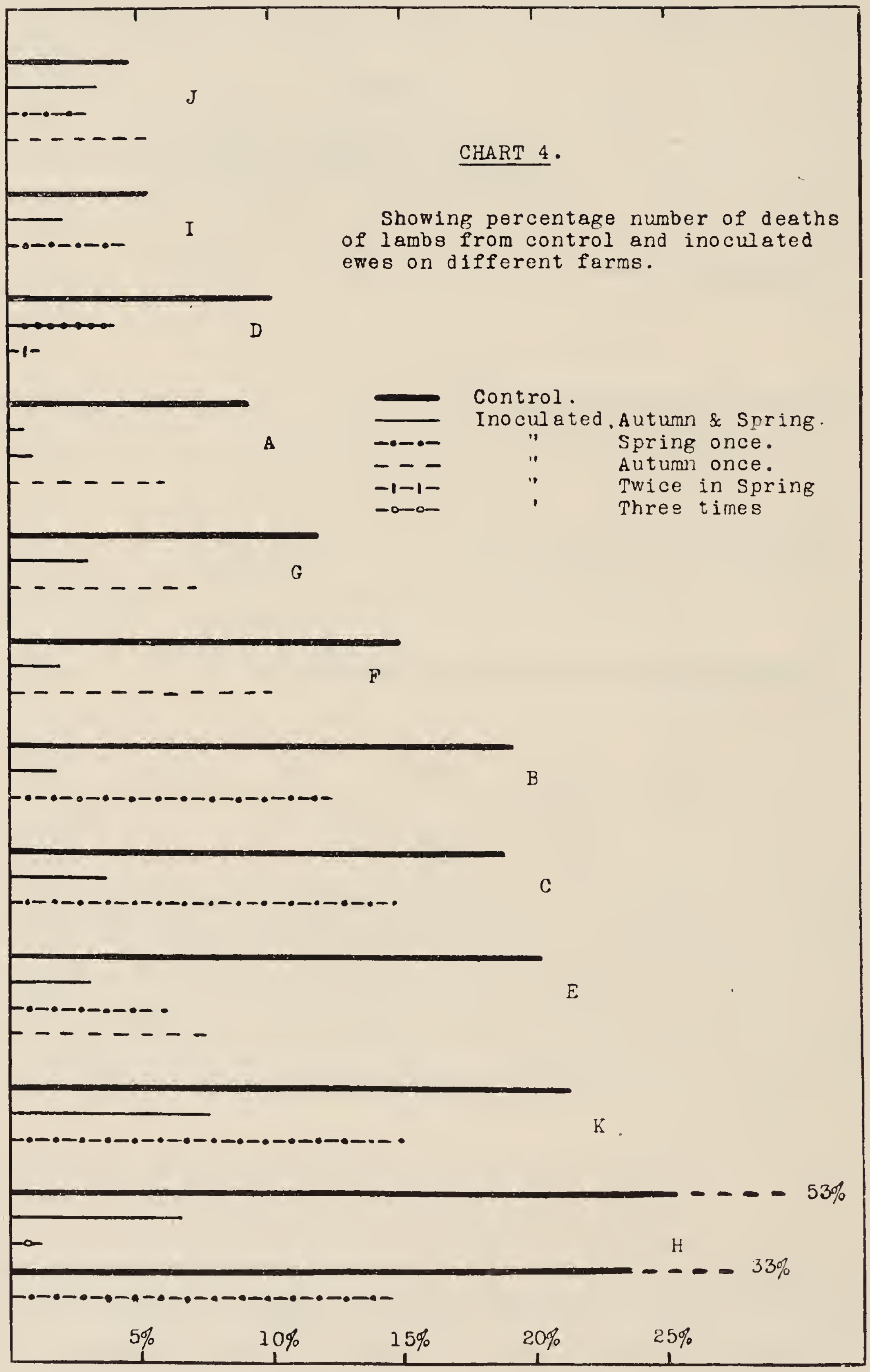
1. A condition apparently identical with naturally occurring lamb dysentery has been produced in young healthy lambs on a clean farm by the following methods: (*a*) Feeding material from the intestine of naturally affected lambs; (*b*) injecting similar material intravenously; (*c*) feeding either a mixture of B. welchii and B. coli or a culture of virulent B. welchii: (*d*) intravenous inoculation of B. coli followed by the feeding of B. welchii culture.

2. In all except the last method (where no serum experiments have been done) the use of B. welchii antiserum prevents infection.

3. It has not been found possible to infect lambs *via* the umbilicus except in one case.

4. Inoculations with a prophylactic containing B. welchii toxin-antitoxin and B. coli vaccine were carried out. Of 5760 lambs born

of 4724 ewes inoculated in autumn and spring, 3·06 per cent. died of lamb dysentery. Of 2509 lambs born of 2248 control uninoculated ewes, 16·06 per cent. died of lamb dysentery. When a single spring inoculation was given the figures were—inoculated ewes 7223, lambs 8497, mortality 5·34 per cent.; control ewes 4633, lambs 5131, mortality 11·59 per cent.



5. Amongst 456 lambs injected with double serum, *i.e.*, anti-welchii and anti-coli, 1·9 per cent. died, while amongst 425 control lambs on the same farms the mortality was 22·6 per cent.

ACKNOWLEDGMENTS.

We desire to express our grateful thanks to Dr R. A. O'Brien for his interest and suggestions during the whole of our work and for the part he played in collecting the details of results. To the various farmers and shepherds in Northumberland and Scotland who have worked in collaboration with us and have been public-spirited enough to keep adequate controls exposed to the full natural losses caused by the disease, and to those farmers who were good enough to present us with healthy lambs, we feel deeply indebted. Our grateful thanks are also due to the Duke of Northumberland, who, through the agency of F. W. Hall, Esq., generously put at our disposal thirty lambing ewes and their progeny, as well as two clean fields.

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2. Dalling, T., Allen, H. R., and Mason, J. H.: Veterinary Record, 11th July 1925, p. 665.
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STATISTICAL NOTE.

By M. Greenwood, F.R.C.P.

Mr Dalling and Dr O'Brien have asked me to test whether, having regard to the numbers of observations but assuming that inoculated and control animals were strictly comparable, the difference between the observed rates of mortality in the paired series are greater than one would expect to arise frequently in mere random sampling.

For this purpose I have used the method employed by Greenwood and Yule in studying records of inoculations against diseases of men (Greenwood and Yule, "Proc. Roy. Soc. Med., Section of Epidem.," 1915, Vol. VIII., pp. 113-190) with the modification suggested in the papers of Fisher and Yule (Fisher, "Journ. Roy. Stat. Soc.," 1922, Vol. XXXV., pp. 87-94; Yule, *ibidem*, pp. 95-104).

For rough purposes, one may say that any value of the function χ^2 entered in the subjoined table which exceeds 10 measures an event the odds against the occurrence of which are more than 600 to 1. Hence, when values of this order occur, it is evidently reasonable to argue that it is more probable that the difference upon which the value of χ^2 depends is produced by some large specific factor than that it is due to the interplay of the numerous small, independent factors covered by the word chance.

As appears from the table, the mass comparisons, except that of the single autumn inoculations, give values of χ^2 much greater than 10. The comparison of the inoculations of lambs also leads to an inference that the advantage of the inoculated animals can hardly be a chance event. Five out of the six individual comparisons lead to the same conclusion. I am, of course, not in a position to criticise the data themselves, *e.g.*, to express an opinion whether the farms tested are a proper random sample of all farms. I can only say that from the arithmetical evidence submitted, the *prima facie* inference—the strong *prima facie* inference, is that the treatment was of value.

THE LATE SIR STEWART STOCKMAN.

It is with infinite regret that we record the death of Sir Stewart Stockman, which occurred suddenly on the 2nd June in Glasgow, at the residence of his brother, Professor Ralph Stockman. He had returned only a few weeks previously from the Argentine, which he had visited partly for the benefit of his health and partly to inquire into matters connected with foot-and-mouth disease.

Sir Stewart, who was born in 1869, was the fourth and youngest son of Mr William John Stockman, merchant, of Edinburgh and Leith. He received his general education at the Edinburgh High School, and his professional training at the Royal (Dick) Veterinary College, from which he qualified as a Member of the Royal College of Veterinary Surgeons in 1890. He afterwards studied for some time at the École Nationale Véterinaire, Paris, and in 1892 he was appointed Professor of Pathology in his *alma mater*. He resigned this appointment in 1900 to serve in the South African War, at the close of which he was awarded a Queen's medal with four clasps. After a brief period of service in the Civil Veterinary Department in India he returned to South Africa in 1902, this time to take up the duties of Principal Veterinary Officer in the Transvaal. He held that office for three years, and in 1905 he was appointed Chief Veterinary Officer to the Board (now the Ministry) of Agriculture, London.

It is not intended here to attempt to set out, even in outline, the valuable work which Sir Stewart Stockman managed to accomplish during the thirty-six strenuous years of his professional life. Epizootiology became his chief study, and his claim to a high place among the most distinguished veterinary scientists of this or any country might be based solely on what he did in that important field. It was through his initiative and influence that the veterinary staff of the Ministry was gradually developed to its present high degree of efficiency as an instrument for the prevention and control of the contagious diseases in Great Britain. A solid foundation for the duties which he overtook at the Ministry was laid during the earlier years of his career when he had to teach pathology in the Royal (Dick) Veterinary College, and subsequently when he obtained excellent opportunities for studying the epizootic diseases that are prevalent in India and South Africa. His success at the Ministry was due to the fact that he combined with a knowledge of the